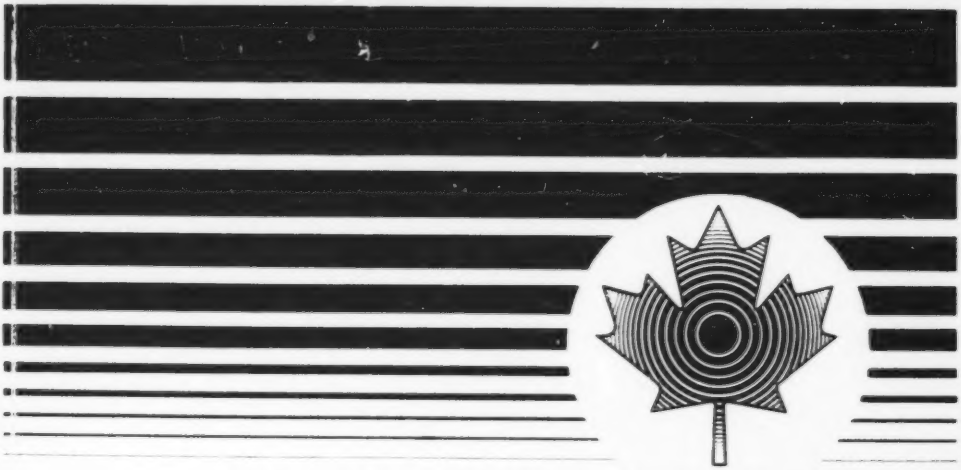
Energy Policy and the Balance of Payments: An Outline of the Issues

T. L. Powrie



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PREFACE

I am grateful to Bruce Wilkinson, John Dawson and David Slater for comments and criticisms on this study. The faults remain my own.

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Chapter 1

INTRODUCTION

The National Energy Board last February estimated that, according to specified criteria, Canada has a surplus of two trillion cubic feet of natural gas. At $2.00 per thousand cubic feet that would bring $4 billion worth of revenue in the export market, and the export price would be higher than that.

Canada's exports are currently falling short of her imports by over $5 billion per year. Is this large deficit in itself a reason to export more natural gas, especially the specified surplus? This study addresses that question, albeit in rather abstract terms. (But greater abstraction provides wider applicability, and the arguments here apply not only to the role of gas exports in the balance of payments but also to other aspects of energy policy in relation to the balance of payments, such as the question of whether our large current account deficit is, in itself, a reason to encourage import replacement by faster development of oil sands, heavy oil, coal, or nuclear power for domestic needs.)

Any given change in exports or imports will of course have its direct impact on the balance of trade. But it will also have ever widening rounds of indirect effects on international payments, through feedback from effects on employment, investment, the exchange rate, perhaps the money supply, and so on. This study is an outline of these complexities. Its conclusion, when all has been taken into account, is that balance-of-payments effects are both transient and of low priority in decisions about energy policy.

For example, additional exports of natural gas would obviously improve Canada's trade balance immediately. However, these additional gas exports would also lead, sooner or later, through exchange rate adjustment or other means, to offsetting changes in other exports or in imports or in capital inflows. That is, extra gas exports by themselves would give only a temporary improvement to the balance of payments, even if the gas exports themselves continued in perpetuity. Even a temporary improvement may, of course, be welcome, but its later effects may not be. For example, additional gas exports, by strengthening the Canadian dollar in foreign exchange markets, may weaken the

position of Canadian manufacturing industry against world competition, and cause the manufacturing sector in Canada to be smaller and the deficit on foreign trade in manufactured goods to be larger. This sort of consideration of the broader effects of gas exports does not automatically imply that gas exports are undesirable. It does mean that decisions about gas export permits should be based on an appraisal of these broader effects on the Canadian economy, including effects on employment, the price level, productivity and the rate and direction of growth. Effects on the balance of payments are of significance only as intermediate steps in the processes by which these more basic goals are won or lost.

Chapter 2

TRADE IN 'ENERGY' IN THE CANADIAN BALANCE OF PAYMENTS

This chapter is a survey, mainly with charts, of developments in the Canadian balance of international payments during the 1970s, with special attention to trade in fuels and electricity or 'energy' for short. Associated statistics and notes are in Appendix A. Full data for 1978 are not yet available, but there appears to have been no major break in trends from 1977.

The Canadian dollar weakened sharply in 1977 and 1978 in the foreign exchange market, after fluctuating near equality with the U.S. dollar in the earlier 1970s. Chart 2.1 shows this recent rise in the Canadian dollar price of a U.S. dollar.

Chart 2.2 is a summary of the components of the balance of payments in the 1970s, to show the underlying reasons for the weakening of the dollar. The usually positive balance of merchandise exports over merchandise imports has been overwhelmed since 1974 by a large growing deficit on trade in services, especially including travel expenditures and payments of interest and dividends. Until 1976, the resulting overall current account deficit was offset by strong net inflows of foreign capital. But beginning in 1977, the capital inflows diminished while the deficit on current account remained large. The resulting shortage of foreign funds caused their Canadian dollar price to rise, a rise that was resisted but not prevented by official sales from the foreign exchange reserves.

Merchandise trade provided a net surplus of foreign currency to the Canadian economy, except in 1975. Chart 2.3 shows merchandise trade divided between energy and all other merchandise. Trade in energy has provided a consistent surplus of export earnings over expenditure on imports. Trade in all other merchandise returned to a surplus balance in 1977 after three years in deficit.

As Chart 2.4 indicates, exports of energy rose to 16 percent of all merchandise exports in 1975, and have declined since then to 12 percent in 1977. This pattern for energy exports is the combined result of the abrupt steep rise in their prices after 1973, and of decline in their volume.

Chart 2.5 shows a similar pattern for imports of energy. Sharply higher prices caused them to increase as a percentage of total merchandise imports in the mid-1970s, and steadily declining volumes have predominated since then to reduce this percentage again.

Prices of different types of energy are illustrated in Chart 2.6. Crude petroleum led the upsurge of energy prices, but other products have followed. The rise in the price of exports of natural gas was somewhat delayed, but by 1977 it had experienced the largest relative increase of all from levels of the early 1970s.

Chart 2.7 shows volumes of exports and imports of energy. Changes here are much less substantial than changes in prices. Most notable is the more rapid decline of the volume of exports than of imports of crude petroleum after 1972; other transactions have followed fairly flat trends in volume, aside from recent increase in exports of natural gas and electricity.

Chart 2.8 is a summary of the value of exports and imports of each of the five types of energy. Crude petroleum and natural gas are by far the most important products in total value of foreign trade. By 1977, trade in crude petroleum had fallen into a deficit of some $1.4 billion, which was more than offset by a surplus of some $2.0 billion from natural gas. While much smaller in total value, trade in petroleum products and in electricity together contributed a surplus of about $0.8 billion in 1977. Trade in coal was nearly in balance, and the overall energy account was in surplus by about $1.4 billion.

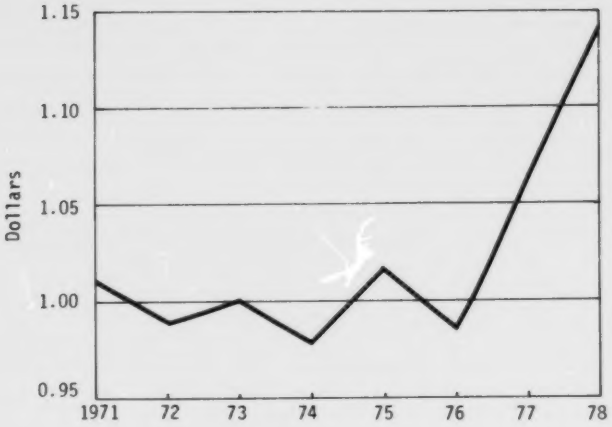


CHART 2.1: Price of U.S. Dollar in Canada
(yearly average)

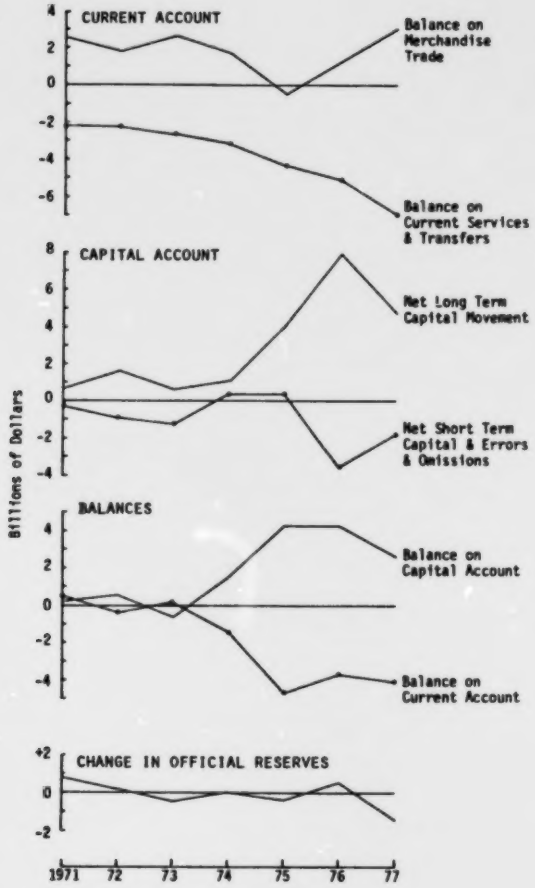


CHART 2.2: Summary of Canadian Balance of International Payments

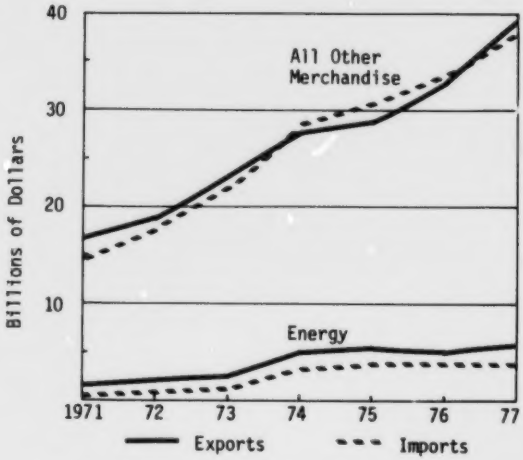


CHART 2.3: Canadian Merchandise Trade in Energy and in All Other Merchandise

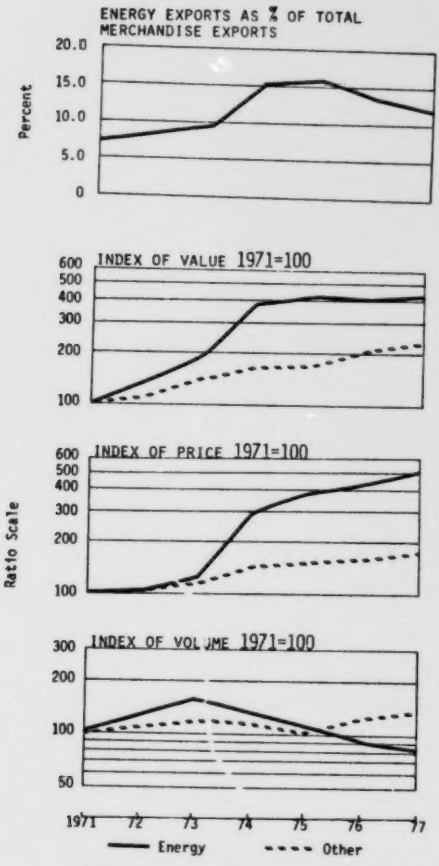


CHART 2.4: Exports of Energy Compared With All Other Merchandise Exports

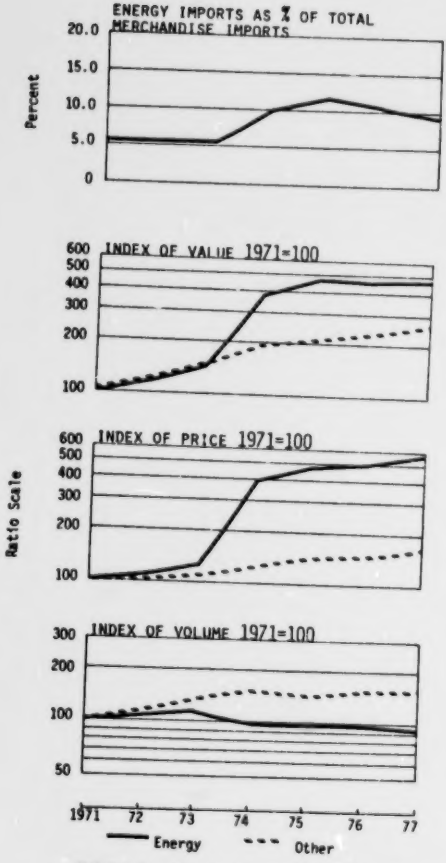


CHART 2.5: Imports of Energy Compared With All Other Merchandise Imports

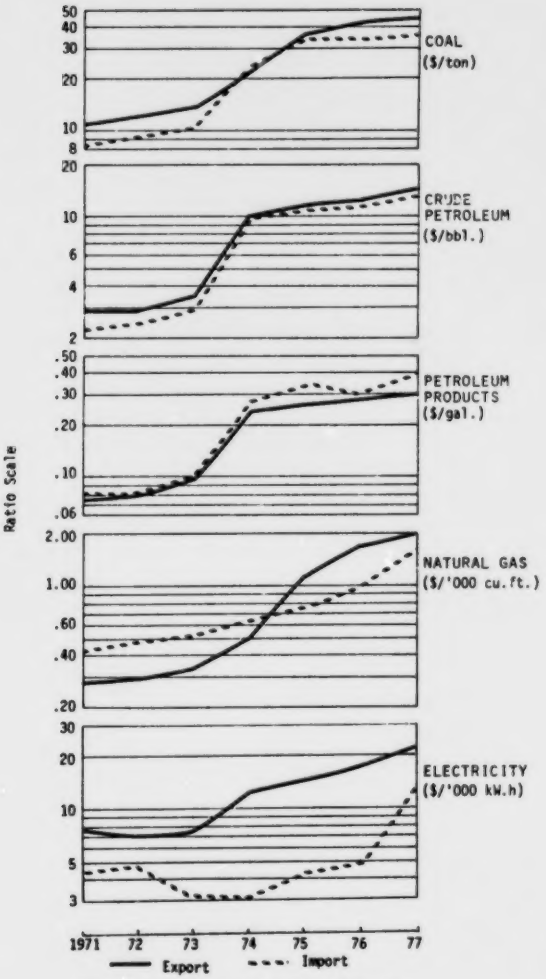


CHART 2.6: Prices of Exports and Imports of Types of Energy

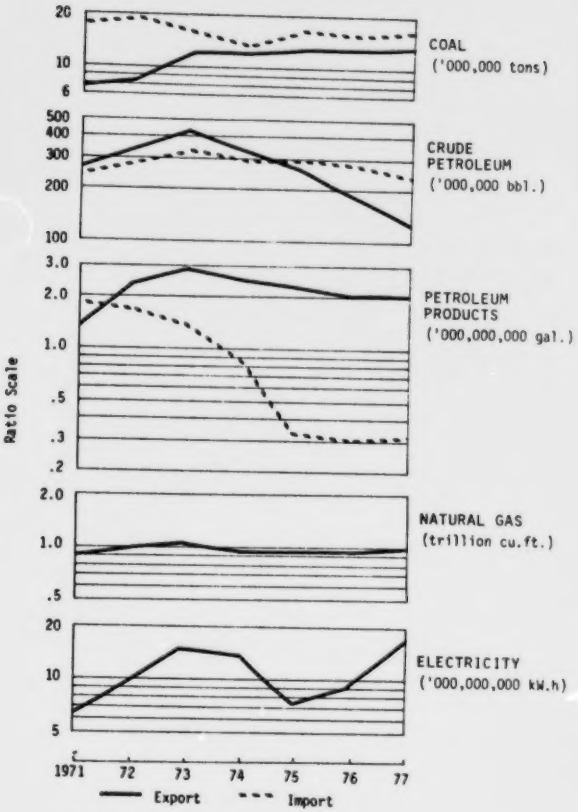


CHART 2.7: Volumes of Exports and Imports of Types of Energy

NOTE: Imports of natural gas and of electricity are too small to show meaningfully on this ratio-scale chart.

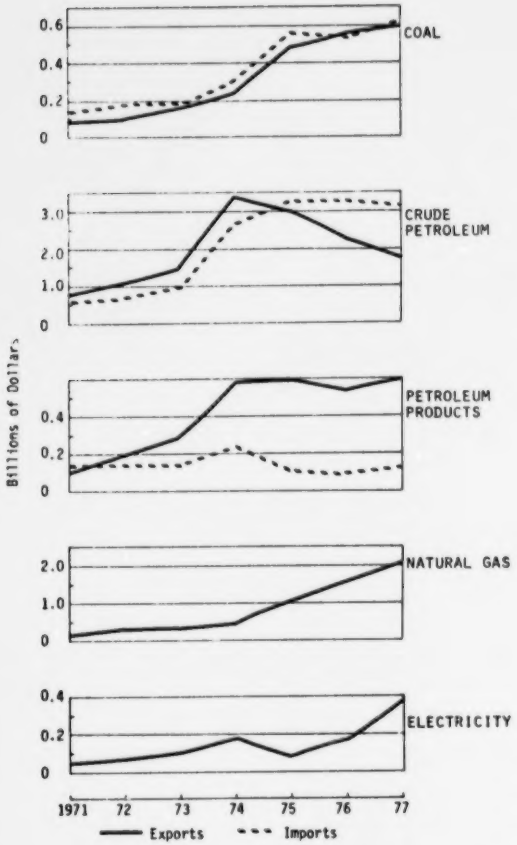


CHART 2.8: Values of Exports and Imports of Types of Energy

NOTE: The values of imports of natural gas and of electricity are too small to distinguish from zero on the scale of this chart.

Chapter 3

BALANCE-OF-PAYMENTS ADJUSTMENT

The purpose of this section is to describe the effects on Canada's balance of international payments of some given increase in exports. Obviously, the first effect is to strengthen the Canadian dollar in foreign exchange markets. However, this immediate effect is followed by ever widening tangles of other effects throughout the economy that feed back upon the balance of payments in a variety of further ways. Our goal here is to describe these further and sometimes complex repercussions, and to judge their degree of importance.

A 'balance-of-payments-impact study' looks at the consequences for the balance of payments of a major decision or project. It normally looks at the additional exports that might be generated, the additional imports that might be required for the construction or operation of the project, and possibly at some other further effects on the balance of payments such as the inflow and later cost of any foreign financing of the project or the import content of the consumer spending of workers employed in it. Balance-of-payments-impact studies can give quite different answers, depending on what arbitrary decision is made about how wide a set of repercussions of a project should be included in the study.

The present discussion is ambitious; it tries to spell out <u>all</u> the repercussions for the Canadian balance of payments of additional exports of natural gas to the United States. The ideas would in general apply to any given change in exports or in imports.

It is difficult to describe in words the interconnections of the parts of the economic system when they are all changing at once. Algebra is a more powerful language than words for that sort of essay. The verbal text here necessarily does one piece at a time; an algebraic approach is set out in Appendix B to provide a more formal and simultaneous description.

The effects of additional exports of natural gas on the balance of payments are:

(a) Direct impact on the trade balance and foreign exchange market

A given increase in gas export means additional earnings of foreign currency and an improved balance of trade. When the exporters convert their foreign currency into Canadian dollars, they add to the demand for and strength of the Canadian dollar in the foreign exchange market.

Companies may choose for various reasons to postpone or avoid the conversion of export revenue into Canadian funds. This choice would delay or weaken the impact of export sales on the foreign exchange market. The timing and the size of the effect on the foreign exchange market may therefore be uncertain, but the direction of the effect is clearly favourable.

(b) Effects on imports through employment and incomes

Additional exports are a stimulus to employment. Exports create jobs in the production of the exports themselves, and further jobs through the multiplier process, which is to say through the extra consumer purchases of those who acquired those jobs. In addition, export demand encourages, and export revenue helps finance, additional investment in the exporting industry. In the case of natural gas, this investment would especially include exploration and development.

At present (early 1979), the effect of additional gas exports is more likely to be the preservation of existing jobs in exploration and development, rather than the creation of additional ones. This is because reserves seem adequate at present for current rates of sales, so exploration is likely to decline if sales are not increased.

Either the creation of new employment or the preservation of existing employment affects the balance of payments. Imports are increased or sustained by the import content of investment and of the consumer purchases that jobs allow. This effect on imports must offset part of the initial improvement in the trade balance, but cannot offset more than a fraction of it in normal circumstances.

(c) Effects on exports and imports through the exchange rate

Under Canada's present exchange rate system of managed floating, the government intervenes directly in the foreign exchange market (sometimes of late very strongly) to resist temporary fluctuations in the rate, but does not prevent longer-term trends in the market. This sort of official intervention in the market is often

called 'leaning against the wind', although it might lately have been called 'grappling against the gale'. The authorities sell foreign currency from the foreign exchange reserves when the price of foreign currency is rising, and they buy when the price is falling.

Additional exports of gas will tend to strengthen the Canadian dollar in foreign exchange markets, as indicated in (a). Under our managed float the authorities will resist but not ultimately prevent this strengthening by purchases of foreign currency while its price is falling. If the authorities believe the Canadian dollar is at present undervalued, their resistance to its strengthening might be rather mild.

The competitive strength of Canadian producers in world markets depends in part on the Canadian exchange rate. A strengthening of the exchange rate weakens this competitive position, both for exporters of Canadian goods to foreign markets and for domestic producers who must compete against imports in the home market.

Recent trade figures seem already to be showing the benefits to our trade balance of a devalued Canadian dollar, although the improvement is obscured by growing payments for services and sluggish growth in export markets. Appreciation of the Canadian dollar would diminish this gain to the balance of payments.

In short, additional gas exports will, through their effect on the exchange rate, displace other exports and increase other imports. This effect is delayed. It takes time for new contracts to be signed and for production to be adjusted. But, although it may take two or three years for this effect to become important, it is important. It affects the structure of the Canadian economy. Some, probably most, of the displaced exports and added imports will be manufactured goods, so the proportion of manufacturing in the national product is reduced. The balance of exports and imports enjoys only a transitional and temporary improvement. If the exchange rate is fully allowed to float, and if there are no changes in net capital flows, extra gas exports must push the exchange rate to a level at which changes in other exports and imports offset exactly any improvement in the trade balance from the gas exports. The improvement in the balance of exports and imports will be more prolonged to the extent that the proceeds of additional sales of gas are used either to add to the foreign exchange reserves or to reduce net inflows in the capital account of the balance of payments, because these alternatives would prevent the movement of the exchange rate. These alternatives are considered in later sections.

One should mention a by-product of exchange rate adjustment, affecting labour. Manufacturing is on average more labour intensive than is gas production. Therefore, to the extent that additional gas exports displace manufacturing production in Canada, there is likely to be some net loss of jobs.

(d) Effects on the foreign exchange reserves

If the Bank of Canada chooses to do so, it may delay or prevent the above appreciation of the Canadian dollar in the foreign exchange market. It could do so by buying some or all of the additional foreign currency earnings from the additional gas exports, as they enter the foreign exchange market for conversion into Canadian dollars, and adding them to the foreign exchange reserves.

The Governor of the Bank of Canada, in an appearance before the House of Commons Finance Committee in February this year, spoke favourably of additional natural gas exports because they would strengthen the trade balance, and thus either the exchange rate or the foreign exchange reserves. The two effects are, of course, alternatives; more of one means less of the other. That is, if the goal is to strengthen the exchange rate, then the additional export earnings must be left in the market and not purchased by the authorities to add to the reserves. If the goal is to build up the reserves, the purchases of foreign currency to do so will resist the strengthening of the exchange rate. Either way, the Governor's comment seems out of harmony with the argument of this paper. At least, out of its context, it sounds like a short-term firefighting approach to the foreign exchange market itself, whereas this paper emphasizes that gas exports should be appraised for their effect on more fundamental objectives, toward which the exchange rate is only a means. But the Governor's comment is out of its context here, no doubt to its detriment.

To avoid the effect (c) above, the displacement of other exports and import-substitutes, it would be necessary to use the additional gas-export earnings for additions to the foreign exchange reserves. Such a policy is sometimes called 'dirty floating' by the neighbours of the country that does it, because they may feel it gives an artificial and unfair competitive advantage to that country through an artificial and unfair level of exchange rate. The advantage is real enough; whether it is artificial and unfair is an important topic for economic diplomacy that must be explained and negotiated so as to preserve stability and co-operation in the international financial system.

To the degree that the proceeds of extra gas exports are added to the foreign exchange reserves, effect (c) above is avoided, and the transactions are essentially the trading of one asset for another. That is, the nation in total sells some of its stock of natural gas in order to increase its stock of foreign currency holdings.

(e) Effects on the balance of payments through the domestic money supply

Any purchase of foreign currency into the Exchange Fund Account tends to expand the domestic money supply. That is, the purchase of foreign currency by the Exchange Fund is normally paid for with Canadian dollars from the government's account in the Bank of Canada. These Canadian dollars are then deposited by their recipient in a Canadian chartered bank, where they are an increase in the cash reserves of the banking system and permit an expansion of bank lending and bank deposits.

The Bank of Canada can, at its discretion, prevent this effect by means of offsetting sales of bonds in the bond market. To the extent that the Bank's main concern is to combat inflation, it is more likely thus to 'sterilize' the foreign exchange reserves and prevent expansion of the domestic money supply. But the Bank also has an eye on the state of the balance of payments, and it may decide to permit some easing of monetary policy merely because the extra gas exports have strengthened the balance of payments. The size of this effect is not at all predictable, being a product of flexible discretion that adjusts to changing conditions and priorities.

If the authorities do decide to permit some growth of the money supply because of a stronger balance of payments, this decision will in turn affect the balance of payments. First, easier money and lower interest rates will stimulate spending on domestic investment projects and consumption, and imports will rise because these expenditures have some import content. Second, lower domestic interest rates will cause more borrowers to use domestic rather than foreign sources of loans, and thus will reduce capital inflows from abroad.

The second of the above effects tends to prevent effect (c). That is, if an easier money policy is introduced as a result of additional exports of gas, then the extra gas exports will in part displace foreign borrowing rather than other exports and import replacements. Reduced foreign borrowing would offset the effect of increased gas exports, in the foreign exchange market, so appreciation of the Canadian dollar would not occur and the competitive position of

exporting and import-replacing industries would not be damaged by appreciation of the Canadian dollar. Here again the effect would be essentially a portfolio adjustment; the nation in total sells some of its stock of natural gas in order to avoid some increase in its international debt.

(f) Effects on the balance of payments through foreign ownership

It was noted in the section above that one possible result of additional gas exports could be reduction of the size of, or at least of the growth of, Canada's international indebtedness. This effect would be a long-term benefit to the balance of payments because it would reduce the annual payments of interest and other debt charges.

An opposite long-term effect would also be present in the case of gas exports, or of exports from any industry in which foreign ownership is substantial. The added exports will, or at least should, generate additional net profits for the industry. But to the degree that these profits are foreign owned, they are a burden on the balance of payments. The burden is immediately felt if the profits are repatriated to their country of ownership. In the case of gas, it is more likely that they would be reinvested in further exploration in Canada, thus leading to an increase in foreign owned investment in Canada and in longer-term costs of debt financing.

(g) Effects on the balance of payments through inflation

The formal model in Appendix B does not allow for any effects of inflation. Therefore we turn, in this section, to a report from the Bank of Canada Review of November 1978, written by T. Maxwell, which describes an experiment with the Bank's large econometric model to investigate the various effects of a given increase in Canadian exports.

The two opposing effects on inflation appear in that experiment. First, additional exports are an increase in the total pressure of demand on the economy, and therefore they tend to aggravate inflation. But second, additional exports strengthen the exchange rate, and this has an important anti-inflationary effect. The net effect, in this experiment with the Bank's large model, is a reduction in the rate of inflation in the economy. It may be that this net favourable effect on inflation would be larger in the early 1980s than indicated by the model, because of relatively greater excess capacity in the economy now than in most of the years covered in the model.

Reduced inflation would, in turn, tend to strengthen the current account in the balance of payments, by leaving export and import-competing industries more competitive in world markets. This benefit to the current account is self-destroying and transitional, of course, because it leads to offsetting change in the foreign exchange rate, unless the improvement in the current account is somehow accompanied by offsetting change in capital flows.

(h) Effects of a cessation of temporary additional gas exports

It is important to note that all of the above effects are the results of a permanent increase in the level of export sales. Gas exports obviously cannot continue indefinitely, so it is also relevant to look at the effects of a future cutback from any temporarily higher level of sales. These effects are of less urgent present concern the longer the added flow of sales can be maintained.

In general, the reduced exports would have all effects in reverse of the increased ones, although not in perfect symmetry as to size or timing because human expectations and decisions may be different in response to a reduction than to an increase.

In summary, a given increase in exports has the following effects on the rest of the balance of international payments. First, because it stimulates employment and income, it leads to some increase in demand for imports. Second, because it creates additional earnings of foreign currency, it leads either to an increase in the foreign exchange reserves or to an appreciation of the Canadian dollar in foreign exchange markets, or to some combination of these. Appreciation of the Canadian dollar in turn causes other imports to increase and other exports to decrease. An increase in the foreign exchange reserves will, unless offset by other measures at the discretion of the central bank, cause an increase in the domestic money supply and thus lower domestic interest rates, which, in turn, may stimulate the economy and increase the demand for imports, and also reduce net inflows of foreign capital. In short, a given increase in exports sets in motion a series of events which, one way or another, leads to increased imports, reduced other exports, and reduced net capital inflows, in some combination that leaves the overall balance of payments ultimately unimproved.

The formal model in Appendix B supports this conclusion, but one should note that the conclusion is not confined to that model. Because the model in the appendix does not incorporate any long-run growth of the economy, there can be no continuing net international

capital movements in it and the current account balance must therefore always revert to zero. Therefore, in that model, all of the long-run effect of extra gas exports must be in the current account, in the form of increased imports or reduced other exports. A model containing long-run growth would also contain the possibility of long-run continuing capital flows and changes in them. The broad conclusion is inescapable both in all theoretical models and in practice, that the ultimate net balance-of-payments effect of anything is zero; extra gas export revenues will, after some set of transitional events, be offset by higher imports or reduced other exports or reduced capital inflows. The important question then is, what happens to the rest of the economy in the process? We turn now to that question.

Chapter 4

EFFICIENCY, PRUDENCE, RESPONSIBILITY, AND THE BALANCE OF PAYMENTS

Efficient use of the nation's resources means putting them to their most valuable uses. As an extreme example, it means using some land, labour and capital to produce wheat for export to earn enough foreign currency to import a ton of bananas, rather than using those same resources to produce a few pounds of bananas directly at home. This is the principle of comparative advantage.

To narrow a current account deficit, any increase in exports or any decrease in imports will do. Efficiency of production, or comparative advantage, does not matter if the only objective is to improve the balance of payments. Even uncompetitive subsidized exports, or high cost import replacement, will do that job.

But efficiency does matter, of course, because it contributes to our standard of living. Therefore it is important, when the current account balance needs improvement, to seek to improve it from those industries where our land, labour and capital are most productive of either exports or import-replacements.

It follows that the question, "Will additional exports of natural gas help our balance of payments?" should be expanded to become, "Will they help in the most efficient way, compared with alternative exports and import-replacements?". This expansion is important because any improvement from one source in the current balance tends to displace other possible sources of improvement. For example, additional exports of gas may preclude some import replacement of oil or manufactured export, so it is important to choose the more efficient alternative.

Additional borrowing from abroad is also a means to strengthen the overall balance of payments. Any sort of borrowing, on any terms, will improve the overall balance in the short run. As some patrons of pawnshops may seem to agree, the cost of a loan does not matter if the only objective is to acquire additional immediate financing.

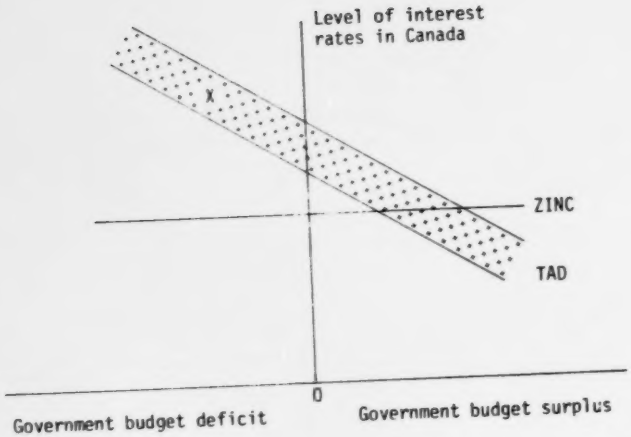
But the cost of borrowing is, of course, also important because it affects our standard of living. Long-run prudence tells us to restrict our borrowings to those loans whose proceeds can be used to earn more than enough income to cover the cost of the loan.

The permanent sale of assets to non-residents is akin to borrowing, except that repayment of the principal is not involved. Again, any sale of assets will improve the balance of payments, but the only prudent sales are those whose proceeds are worth more to us than is the asset that is sold.

There is always an alternative to borrowing or sale of assets; domestic savings could be increased instead. Greater domestic savings are essenti l if we are to maintain a high rate of investment while reducing the rate of growth of international debt to a less disturbing level. In this respect, a nation is like a household. A household may purchase a dishwasher either by borrowing money or by cutting back on other purchases and thereby leaving a larger estate to its heirs. The issue here should not perhaps be called one of either efficiency or prudence, but rather one of responsibility. What is involved is the choice between present consumption and future consumption, that is, the balancing among our responsibilities to our present selves, our future selves, and our successors. To improve our present balance of payments by long-term borrowing or by sales of assets is to impose a burden on the future. To impose the burden on ourselves, we would have to export more and import less now, and to save more and consume less to release the exports and foresake the imports.

In addition to the goals of efficiency, prudence, and responsibility, there are the more urgent problems of unemployment and inflation to consider. Again, we consider how these problems might be affected by extra gas exports, because of our view that events in the balance of payments are important only for their domestic effects and not in their own right.

The following diagram is a form of summary of this topic. The level of interest rates in Canada is measured on the vertical axis. The size of the government's budget surplus (or deficit) is measured rightward (or leftward) from zero on the horizontal axis.



The label TAD means 'Target level of Aggregate Demand'. There are different combinations of monetary and fiscal policy that will yield the desired level of aggregate demand in the economy. These combinations are shown by the band TAD on the diagram. (They are drawn as a wide band and not as a single line in order to accommodate, and thus bypass, debate on what is the desirable level of aggregate demand at a time of both inflation and unemployment.) At any point above TAD, the mix of monetary and fiscal policy is too restrictive and unemployment is generally agreed to be the main problem. At any point below TAD, the mix of monetary and fiscal policy is too expansionist, and there is general agreement that the main problem is inflation. The band TAD slopes downward to the right; that is, to preserve any target level of aggregate demand, an easier monetary policy (lower interest rates) must be accompanied by a tighter fiscal policy (smaller government deficit or larger surplus).

The label ZINC means 'Zero net INflow of Capital'. There is some level of interest rates in Canada, relative to levels in other

countries, that is low enough to make net capital inflows be zero so that the nation's net international debt ceases to grow. (There would still be international flows of investment, but gross inflows would be matched by gross outflows.) The horizontal line labelled ZINC is drawn at this level of interest rates. Given a freely floating exchange rate, net capital inflows attracted by interest rates higher than ZINC cause an appreciation of the Canadian dollar to a level that in turn causes a current account deficit equal to the capital inflow. Exchange rate adjustment always pushes the net total of exports, imports and net capital flows toward zero, under a floating exchange rate. At interest rates above ZINC, the components of this net total are a net inflow of capital and a deficit of exports below imports. (And at interest rates below ZINC, there will be net lending to foreigners offset by a current account surplus.)

Recently, the Canadian economy has been under a policy mix described by the vicinity of point X on the diagram.[1] There has been a level of interest rates sufficient to cause substantial net borrowing from abroad and a higher-than-otherwise exchange rate and current account deficit; there has been a large federal government deficit; and there has been reasonable dispute about whether aggregate demand is too high or too low in the face of our problem of unemployment and inflation combined.

Now, what would extra exports of natural gas do to this situation?

Additional exports of natural gas would shift upward the band called TAD. That is, they would be a new source of aggregate demand and employment, so that a more restrained mixture of monetary and fiscal policy would become appropriate to preserve the desirable level of aggregate demand. This shift in TAD creates both danger and opportunity. The danger is that the policy response might be in the form of higher interest rates, which would, paradoxically, lead to an ultimate worsening of the current account deficit because of their

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[1] One should note that, in the last few years, the policy mix in Canada has moved 'northwest' on the diagram, with a greater restraint in monetary policy and a growing federal government deficit. A policy mix prescribed to maintain a target level of aggregate demand while reducing the current account deficit and the growth of Canada's international debt would be a movement in the opposite direction, to the 'southeast.' Such a prescription is discussed, for example, in Robert M. Dunn, Jr., The Canada-U.S. Capital Market (C.D. Howe Research Institute and National Planning Association, 1978), pp. 114-116.

effect on capital flows and the exchange rate. The opportunity is that the policy response might be on the fiscal side as a reduction in the government deficit and thus an improvement in the national savings rate.

The diagram on the next page summarizes the various broad determinants of the balance of payments, and thus the possible sources of its improvement.

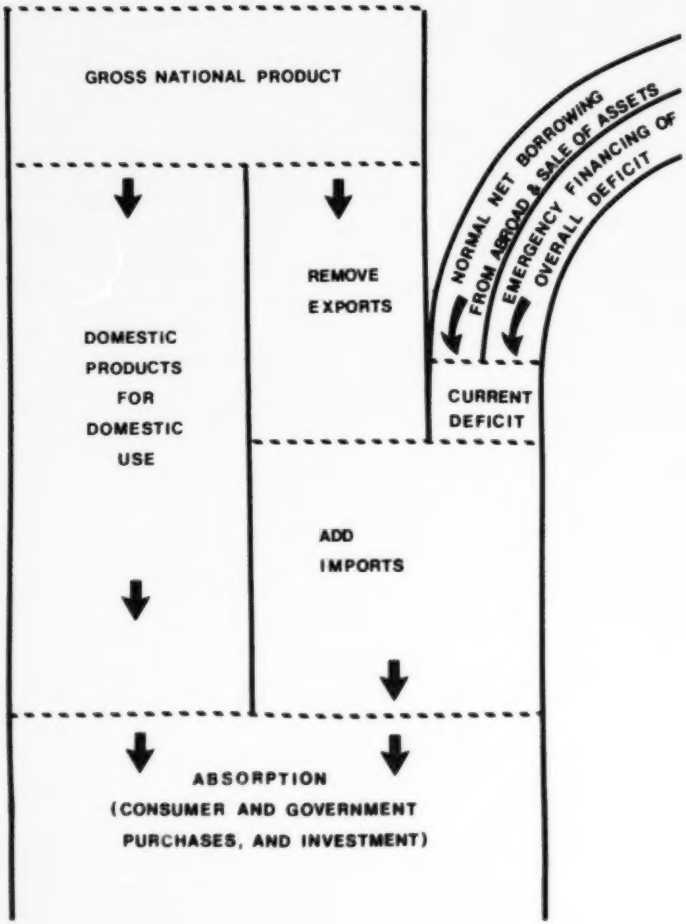
The current deficit in the balance of payments, or excess of imports over exports, appears on the right side of the diagram. It may be financed by 'normal net borrowing from abroad', which mainly means long-term borrowing and asset sales, by either the private or the government sectors, motivated by ordinary financial considerations. If the current deficit is larger than this 'normal' borrowing, then the balance of payments is in overall deficit. It is then necessary to run down the foreign exchange reserves, or arrange special loans from abroad, to cover this deficit until measures are taken to close it.

The overall deficit may be closed:

i) by increased 'normal net borrowing', perhaps encouraged by a tight money policy to encourage borrowers to turn to foreign lenders. This approach raises the issues both of prudence (can we use these loans profitably, net of their costs?) and of responsibility (should we thus put the burden of the deficit on future rather than on present consumption?).

ii) by increasing Gross National Product and ensuring that the extra product is exported and not used at home. At a time of unemployment this is an attractive option, although of course not an easy one to implement as our difficulties in seeking full employment without inflation show. This approach raises the issue of efficiency. We must try to ensure that the additional exports are of products in which we do have a comparative advantage, so that the balance of payments is improved in the least costly way.

iii) by reducing 'absorption'. Absorption is the sum total of goods and services used domestically in the economy. It includes all purchases by consumers and by governments, and also all investment in new capital by business and government. As the diagram shows, the current deficit between exports and imports is, by definition, equal to the excess of our absorption over our GNP. Given some size of GNP, increased exports or reduced imports both mean reduced absorption. More exports or fewer


GROSS NATIONAL PRODUCT
REMOVE EXPORTS
DOMESTIC PRODUCTS FOR DOMESTIC USE
NORMAL NET BORROWING FROM ABROAD & SALE OF ASSETS
EMERGENCY FINANCING OF OVERALL DEFICIT
CURRENT DEFICIT
ADD IMPORTS
ABSORPTION
(CONSUMER AND GOVERNMENT PURCHASES, AND INVESTMENT)

imports inevitably means less for use at home. Reduced absorption raises all the issues of efficiency, prudence and responsibility. Since it means more exports and less imports, it raises the issue of efficient patterns of changes in production. Since it means reduced reliance on normal net borrowing, it involves the questions of the profitability of loans and of present versus future well-being. Since it means a reduction in something, it raises the choice between cutting present consumption or cutting investment, and thus again the matter of present versus future well-being.

The natural gas industry, like the rest of the energy sector, is highly regulated by government. The above scheme suggests that the following questions ought to be answered by the regulators in any appraisal of the contribution of additional natural gas exports to the Canadian balance of payments:

i) Would gas exports be among the efficient sources of additional exports?

ii) Would gas exports be more efficient than use of the gas to replace imports or than other import replacement?

iii) Would gas exports reduce the gap between GNP and absorption? That is, can they increase GNP with a minimum of accompanying increase in absorption?

iv) Would additional gas exports be prudent and responsible? These points arise because gas is an exhaustible resource and therefore involves the questions that arise about the sale of assets as well as the questions that arise about ordinary renewable exports.

Prudence requires a comparison of the value of the gas held as an asset for future use, against the value of the foreign currency earned from its present sale. It contains the question of adequacy of reserves for domestic use. It requires an estimate of the future of the price of gas, so we can judge whether it would be profitable to hold it as an appreciating asset for sale later. It raises the concern about security of supply of an essential material, or how much of an implied premium should there be on greater self-sufficiency in energy over greater dependence on uncertain world supplies.

Responsibility asks us to decide between the sale of assets and the restraint of our consumption of renewable goods and

services as alternative ways of improving the balance of payments. This challenge is both increased and complicated to the degree that added sales of gas lead to increased retained earnings of foreign owned firms and thus to increased international indebtedness.

One conclusion of this paper is that the effect of additional gas exports on the balance of payments would be diverse and complex. This point by itself is not too helpful to a decision maker. It merely tends to cause the native hue of resolution to be sicklied over with the pale cast of thought.

The second conclusion of this paper is likely to be more helpful. Gas sales would give the balance of payments the generally favourable but transient boost described in Chapter 3 above. But so would <u>any</u> sales of any commodity or of any physical or financial asset. Therefore, balance-of-payments effects are irrelevant as a criterion for choosing among alternative transactions. They are similar for all transactions and may pretty safely be ignored in the choice of what to sell or buy.

The last conclusion is again unhelpful in that it raises difficult questions. Since balance-of-payments effects are not a criterion, the <u>only</u> criteria that do apply to a decision about gas export permits are those of efficient present use of present resources, prudent investment in physical or financial assets, and responsible choice between present consumption and future consumption. Some 'only'.

APPENDICES

APPENDIX A

STATISTICAL TABLES

TABLE A.1

CANADIAN BALANCE OF INTERNATIONAL PAYMENTS: SUMMARY, 1971-77
(millions of dollars)

	1 Balance on Merchandise Trade	2 Balance on Current Services & Transfers	3 (1+2) Current Account Balance	4 Net Long-term Capital Movement	5 Net Short-term Capital & Errors & Omissions	6 (3+4+5) Change in Official Reserves
1971	2,563	-2,132	431	664	-318	777
1972	1,857	-2,243	-386	1,588	-983	219
1973	2,735	-2,627	108	628	-1,203	-467
1974	1,689	-3,149	-1,460	1,041	443	24
1975	-451	-4,306	-4,757	3,935	417	-405
1976	1,339	-5,140	-3,801	7,909	-3,586	522
1977	2,916	-7,066	-4,150	4,573	-1,844	-1,421

SOURCE: Bank of Canada Review, 'Change in official reserves' excludes allocation of S.D.R.'s.

TABLE A.2

CANADIAN MERCHANDISE TRADE: ENERGY AND ALL OTHER MERCHANDISE, 1971-77
(millions of dollars)

	1	2	3	4	5	6
	Trade in Energy			Trade in All Other Merchandise		
	Exports	Imports	Balance (1-2)	Exports	Imports	Balance (4-5)
1971	1,272	852	419	16,546	14,766	1,780
1972	1,677	1,010	667	18,473	17,658	815
1973	2,391	1,258	1,132	23,030	22,067	963
1974	4,926	3,199	1,727	27,516	28,523	-1,007
1975	5,337	4,011	1,326	27,991	30,705	-2,714
1976	5,150	3,931	1,219	33,247	33,513	-266
1977	5,353	3,967	1,385	39,023	38,189	834

SOURCE: Statistics Canada Trade of Canada publications, including Merchandise Trade Exports 65-202, and Merchandise Trade Imports 65-203; and Bank of Canada Review. These figures for merchandise trade are not fully consistent with those in Table A.1, because of different definitions, etc., in Trade of Canada data than in balance of payments data. 'Energy' is coal, crude petroleum, petroleum products for fuel, natural gas, and electricity. Radioactive ores and concentrates were not included because Trade of Canada gives no separate price and volume figures for them; their value is relatively small ($75 million of exports in 1977).

The trade categories used from Trade of Canada data are:
Coal: 26110, 26115, 26149, 26169, 26189
Crude petroleum: 26410
Petroleum products for fuel: 43109, 43149, 43199, 43209 43219, 43225, 43240, 43245, 43249, 43259, 43269, 43901, 43962, 43963, 43965
Natural gas: 26431
Electricity: 49704

TABLE A.3

CANADIAN MERCHANDISE TRADE: PERCENTAGE OF VALUE FROM ENERGY AND FROM ALL OTHER MERCHANDISE, 1971-77
(percent)

	1	2	3	4	5	6
	Merchandise Exports			Merchandise Imports		
	Energy	Other	Total	Energy	Other	Total
1971	7.1	92.9	100.0	5.5	94.5	100.0
1972	8.3	91.7	100.0	5.4	94.6	100.0
1973	9.4	90.6	100.0	5.4	94.6	100.0
1974	15.2	84.8	100.0	10.1	89.9	100.0
1975	16.0	84.0	100.0	11.6	88.4	100.0
1976	13.4	86.6	100.0	10.5	89.5	100.0
1977	12.1	87.9	100.0	9.4	90.6	100.0

SOURCE: Calculated from Table A.2.

TABLE A.4

INDICES OF PRICE, VOLUME AND VALUE FOR CANADIAN EXPORTS OF ENERGY AND OF ALL OTHER MERCHANDISE, 1971-77
(1971 = 100.0)

	1	2	3	4	5	6
	Energy Exports			All Other Exports		
	Price	Volume	Value	Price	Volume	Value
1971	100.0	100.0	100.0	100.0	100.0	100.0
1972	104.0	126.9	131.9	103.3	108.0	111.6
1973	121.7	154.5	188.0	117.5	118.4	139.2
1974	297.4	130.2	387.4	144.1	115.4	166.3
1975	383.4	109.5	419.7	156.7	107.9	169.2
1976	443.2	91.4	405.0	162.2	123.9	200.9
1977	509.5	82.6	420.9	173.8	135.7	235.8

SOURCE: Price and volume indices for energy exports and imports are directly constructed from the Trade of Canada data specified in the note to Table A.2. That is, volumes for each year were weighted by 1971 prices to yield a composite volume index for each year. The composite price index for each year is then simply the value index divided by the volume index. The indices for 'all other' exports and imports were found by removal of the energy items from indices for total merchandise trade in Bank of Canada Review. (In certain instances, the combined price and volume indices in Bank of Canada Review were not exactly consistent with the value index; in that event, the price index used was value divided by volume.)

TABLE A.5

INDICES OF PRICE, VOLUME AND VALUE FOR CANADIAN IMPORTS OF ENERGY AND OF ALL OTHER MERCHANDISE, 1971-77
(1971 = 100.0)

	1	2	3	4	5	6
	Energy Imports			All Other Imports		
	Price	Volume	Value	Price	Volume	Value
1971	100.0	100.0	100.0	100.0	100.0	100.0
1972	108.7	109.0	118.5	102.0	117.3	119.6
1973	127.8	115.5	147.6	109.2	136.8	149.4
1974	382.3	98.2	375.4	126.7	152.4	193.2
1975	475.9	98.9	470.6	144.7	143.7	207.9
1976	502.7	91.7	459.9	145.8	155.7	227.0
1977	566.9	82.1	465.4	164.2	157.5	258.6

SOURCE: See note to Table A.4.

TABLE A.6

PRICE INDICES FOR CANADIAN TRADE IN FUELS
AND ALL OTHER MERCHANDISE, 1971-77
(1971 = 100)

	Crude Petroleum	Petroleum Products	Natural Gas	Coal	Electricity	All Other Merchandise
Exports						
1971	100	100	100	100	100	100
1972	102	108	110	111	95	103
1973	121	135	123	123	98	118
1974	353	320	185	189	168	144
1975	400	365	414	331	194	157
1976	431	350	610	384	231	162
1977	498	402	735	400	302	174
Imports						
1971	100	100	100	100	100	100
1972	110	102	110	111	106	102
1973	130	125	121	122	74	109
1974	412	350	143	266	72	127
1975	501	436	171	410	98	145
1976	536	378	225	405	110	146
1977	607	508	360	438	286	164

SOURCE: These price indices for separate types of energy are directly constructed from the Trade of Canada data specified in the note to Table A.2. All prices are the result of dividing value by volume.

TABLE A.7

CANADIAN EXPORTS AND IMPORTS OF COAL, 1971-77

	1	2	3	4	5	6
	Exports			Imports		
	Value $000,000	Volume '000 tons	Price $/ton	Value $000,000	Volume '000 tons	Price $/ton
1971	87	7,666	11.21	151	18,145	8.34
1972	107	8,555	12.45	179	19,275	9.28
1973	165	12,051	13.73	167	16,362	10.21
1974	252	11,918	21.18	303	13,669	22.16
1975	478	12,894	37.07	576	16,834	34.23
1976	557	12,967	42.98	544	16,092	33.83
1977	596	13,304	44.83	618	16,891	36.57

SOURCE: Trade of Canada. See note to Table A.2.

TABLE A.8

CANADIAN EXPORTS AND IMPORTS OF CRUDE PETROLEUM, 1971-77

	1	2	3	4	5	6
	Exports			Imports		
	Value $000,000	Volume '000,000 bbl	Price $/bbl	Value $000,000	Volume '000,000 bbl	Price $/bbl
1971	787	271	2.91	541	245	2.21
1972	1,008	341	2.95	681	281	2.42
1973	1,482	420	3.53	941	327	2.87
1974	3,420	333	10.26	2,646	291	9.09
1975	3,052	262	11.63	3,302	298	11.06
1976	2,287	183	12.52	3,280	277	11.84
1977	1,751	121	14.48	3,209	240	13.40

SOURCE: Trade of Canada. See note to Table A.2.

TABLE A.9

CANADIAN EXPORTS AND IMPORTS OF PETROLEUM PRODUCTS FOR FUEL, 1971-77

	1	2	3	4	5	6
	Exports			Imports		
	Value $000,000	Volume '000,000 gal	Price $/gal	Value $000,000	Volume '000,000 gal	Price $/gal
1971	98	1,344	.073	142	1,790	.080
1972	189	2,393	.079	135	1,660	.081
1973	283	2,878	.098	136	1,377	.099
1974	586	2,507	.234	239	861	.278
1975	611	2,293	.267	113	325	.347
1976	527	2,061	.256	89	295	.300
1977	601	2,045	.294	125	310	.404

SOURCE: Trade of Canada. See note to Table A.2.

TABLE A.10

CANADIAN EXPORTS AND IMPORTS OF NATURAL GAS, 1971-77

	1	2	3	4	5	6
	Exports			Imports		
	Value $000,000	Volume billion cu.ft.	Price $/'000 cu.ft.	Value $000,000	Volume billion cu.ft.	Price $/'000 cu.ft.
1971	251	903	.28	7	16	.44
1972	307	1,007	.30	8	16	.48
1973	351	1,031	.34	8	15	.53
1974	494	961	.51	6	9	.63
1975	1,092	949	1.15	8	10	.75
1976	1,616	954	1.69	9	9	.98
1977	2,028	994	2.04	-	-	1.58

SOURCE: Trade of Canada. See note to Table A.2.

TABLE A.11

CANADIAN EXPORTS AND IMPORTS OF ELECTRICITY, 1971-77

	1	2	3	4	5	6
	Exports			Imports		
	Value $000,000	Volume '000,000 kW.h	Price $/'000 kW.h	Value $000,000	Volume '000,000 kW.h	Price $/'000 kW.h
1971	48	6,458	7.47	11	2,409	4.39
1972	68	9,570	7.10	9	1,823	4.67
1973	109	14,999	7.28	6	1,970	3.26
1974	175	13,886	12.57	5	1,642	3.15
1975	104	7,216	14.45	13	2,940	4.30
1976	162	9,391	17.22	9	1,910	4.81
1977	377	16,715	22.55	15	1,170	12.58

SOURCE: Trade of Canada. See note to Table A.2.

APPENDIX B

A MODEL OF THE PROCESS OF BALANCE-OF-PAYMENTS ADJUSTMENT

Appendix B

A Model of the Process of Balance-of-Payments Adjustment

The following model is meant to illustrate how the 'monetary approach' to the balance of international payments might be grafted on to the 'Keynesian approach.'

For present purposes, at least, the fundamental feature of a 'Keynesian' model is that it is built on the assumption of constant money wages and thus it leads to the conclusion that the labour market does not clear and that unemployment may prevail in equilibrium. Its basic structure is the IS/LM structure plus a foreign exchange market. Again for present purposes at least, the 'monetary' model is built on the assumption that there is an equilibrium relationship between income and financial assets.

The present model thus has four sectors. One is the foreign exchange market. The next two are the commodities market and the money market of IS/LM theory. They are modified to show, first, how the supply of money is affected by events in the foreign exchange market and, second, how the consumption function is affected by households' adjustments of their current savings so as to achieve their desired level of financial assets. To prevent these wealth effects on consumption from having an implausibly overwhelming influence on consumer behaviour, they are assumed to occur only gradually, with only partial adjustment in any one period. The fourth sector is the bond market, with 'bonds' being a composite of all financial assets other than money.

(i) The Foreign Exchange Market

Exports, in domestic currency value, depend on the level of the exchange rate and on an exogenous variable g. This g represents, for example, additional natural gas exports that might or might not be permitted by Canadian authorities. If extra gas exports are not permitted, $g = 0$. If they are permitted, g has some positive value, and it is the purpose of the model to trace the consequences of a positive value for g.

Equation 1. Value of exports depends on the exchange rate, a constant term, and g.

$$X = hR - j + g$$

Foreign investment in Canada is explained, in a cavalier fashion, as a simple stock adjustment of foreign portfolios of Canadian bonds to the interest yield on them.

(Note: For ease of typing, the symbol * is used, rather than a subscript, to mean 'the value of this variable in the previous time period'.)

Equation 2. $BF - BF^* = f(i-i^*)$

The value of imports depends on two causes, the level of aggregate demand in Canada, and the level of the exchange rate.

Equation 3. $Z = zY - vR$

Official intervention in the foreign exchange market is under a policy of managed floating. The authorities do intervene, but not to peg the exchange rate and only to resist movements in it. Changes in the foreign exchange reserves thus are an inverse function of changes in the exchange rate. (The exchange rate is defined as the Canadian dollar price of foreign currency, so that a rise in the rate, R, means a devaluation of the Canadian dollar.)

Equation 4. $E - E^* = -e(R-R^*)$

The exchange rate must move to a level that clears the foreign exchange market. That is, the sum of export earnings plus net new sales of bonds to foreigners must equal the sum of expenditure on imports plus additions to the foreign exchange reserves.

Equation 5. $X + (BF - BF^*) = Z + (E - E^*)$

Substitution of equations 1 through 4 into 5, and rearrangement, gives equation XZ. It is presented in two forms, XZ1 which is convenient for finding the equilibrium of the system, and XZ2 which is convenient for description of the process of the system through time.

XZ1: $$R = \frac{zY + j - g - f(i-i^*) - e(R-R^*)}{h + v}$$

XZ2: $$R = \frac{zY + j - g - f(i-i^*) + eR^*}{h + v + e}$$

(ii) The Commodities Market

Aggregate demand by consumers is equal to national income less all taxes and all household and business savings.

Equation 6. $C = Y - T - S$

Taxes (net of transfers from government) are simply proportional to national income.

Equation 7. $T = tY$

Private sector savings consist of three components. The first is a fraction of the proceeds of the export sales called g. The second is adjustment by households of their holdings of money to the currently desired level. The third is adjustment by households of their holdings of bonds to the currently desired level.

Equation 8. $S = xg + (MD - MD^*) + (BH - BH^*)$

Equation 9. Government current purchases G are given.

Gross investment I consists entirely of reinvestment by business of their saved portion of export proceeds from g. Thus I is zero if g is zero, and is in any event not related to the rate of interest. These points are not important, first, because this is not a growth model so the relevance of I is only its effect on aggregate demand and, second, because aggregate demand is affected by the interest rate through consumption, C. Indeed, one could think of I as representing that portion of investment that is caused and financed by additional sales of exports, while C represents all other private sector consumption and investment expenditure.

Equation 10. $I = xg$

Export sales have already been specified in equation 1, and purchases of imports in equation 3.

In equilibrium, commodities markets must clear.

Equation 11. $C + G + I + X - Z = C + S + T$.

Substitution of equations 1, 3, 6,..., 10 into 11, and rearrangement, gives equation IS.

$$\text{IS1:} \quad Y = \frac{G - j + g + (h+v)R - (MD - MD^*) - (BH - BH^*)}{t + z}$$

$$\text{IS2:} \quad Y = \frac{G - j + g + (h+v)R - i(ka - d) + MD^* + kBH^*}{bk(1-t) + m + t + z}$$

Note that derivation of IS2 also involves equations 15 and 19.

(iii) The Money Market

The symbol # is introduced here to mean 'the value of this variable in the initial period'.

The behaviour of the foreign exchange reserves has been described in equation 4, but can be put in a more convenient form for present purpose.

Equation 4. $E = E^* - e(R-R^*) = E^{\#} - e(R-R^{\#})$

Bond holdings by the central bank, BC, are changed by open market operations of the central bank. If the central bank wishes to prevent any change in the money supply, it must sterilize any increase in the foreign exchange reserves by an equal reduction in its holdings of bonds. Let n be the fraction of changes in the foreign exchange reserves thus neutralized.

Equation 12. $BC = BC^* - n(E-E^*) = BC^{\#} - n(E-E^{\#})$

The cash reserves of the chartered banks, called H, are equal to the total assets of the central bank. (Currency in circulation and other central bank liabilities are thus ignored.)

Equation 13. $H = E + BC$

The chartered banks create deposit liabilities against themselves to the full extent that their cash reserves H and the cash reserve ratio r allow. These deposits are the only form of money. M is the supply of money.

Equation 14. $M = H/r$

The demand for money by the public is MD. It varies directly with national income and inversely with the interest rate.

Equation 15. $MD = mY - di$

The money market must clear.

Equation 16. $M = MD$

Substitution of equations 4 and 12 through 15 into 16, and rearrangement, gives:

$$\text{LM1:} \quad i = \frac{mY - (E^{\#} + BC^{\#})/r + e(1-n)(R-R^{\#})/r}{d}$$

$$\text{LM2:} \quad i = \frac{mY - (E^{*} + BC^{*})/r + e(1-n)(R-R^{*})/r}{d}$$

(iv) The Bond Market

The total stock of bonds in existence, B, changes only through new issues (or retirements) resulting from government current deficits (or surpluses).

Equation 17. $B = B^{*} + G - T = B^{\#} + \Sigma(G - T)$

Total foreign investment in Canada consists entirely of bonds, and has already appeared as equation 2.

Equation 2. $BF = fi$

Bonds held by the Canadian banking system include both BC, those held by the central bank, and BM, those held by the chartered banks. With cash reserves of H and a reserve ratio of r, the chartered banks will hold bonds in the amount of $BM = (1-r)H/r$ as a result of their deposit creation. And, $BC = H-E$. So $BB = BM + BC$ becomes:

Equation 18. $BB = H/r - E$

Bonds held by the household sector, BH, include any held indirectly through loans to the business sector, which itself does not own any net financial assets in this model. BH varies directly with both the rate of interest and the level of after-tax income. That is, the desired level of bond holdings is

$$BHD = ai + b\,(1-t)Y$$

However, if we were to permit instant full attainment by households of BHD, these wealth effects in the savings and consumption functions would be implausibly powerful. Therefore, we introduce a gradual adjustment only, to the amount of the fraction k in any period of the gap between previous BH and current BHD.

Equation 19. $BH = BH^{*} + k(ai + b(1-t)Y - BH^{*})$, and

$BH = ai + b(1-t)Y$ in equilibrium.

The bond market must clear; all bonds outstanding must be voluntarily held somewhere.

Equation 20. $B = BF + BB + BH$

Substitution of equations 2, 17, 18 and 19 into 20, and rearrangement, gives:

$$BB1: \quad i = B^{\#} + \Sigma(G-T) - BC^{\#}/r - E^{\#}(1-r)/r + e(R-R^{\#})(1-n-r)/r - b(1-t)Y \Big/ \quad (a+f)$$

$$BB2: \quad i = B^{*} + G - BH^{*}(1-k) - BC^{*}/r - E^{*}(1-r)/r + e(R-R^{*})(1-n-r)/r - (bk - bkt + t)Y \Big/ \quad (ak+f)$$

(v) Solution of the System in Equilibrium

If any three of the above four markets have cleared, the fourth one must also have done so. In other words, of the four equations XZ, IS, LM and BB, any one could be derived from the other three, and there are only three independent equations to solve for the three main unknowns i, R, and Y.

For a solution of the model in equilibrium, however, it seems necessary to use XZ1, IS1 and LM1, because BB1 contains the troublesome term $\Sigma(G-T)$, which in equilibrium is the summation of an infinite series of dubious character. Once the rest of the system has been solved, and on the assumption that it all converges on a stable equilibrium, then equation 20 can be used to find $\Sigma(G-T)$ as:

$$\Sigma(G-T) = BF + BB + BH - B^{\#}$$

Setting $(i-i^{*})$, $(R-R^{*})$, $(MD-MD^{*})$ and $(BH-BH^{*})$ all equal to zero and solving XZ1, IS1 and LM1 gives the following equilibrium solutions:

$$R = (zG + tj - tg)/t(h+v)$$

$$Y = G/t$$

$$i = \frac{mG}{td} - \frac{(E^{\#} + BC^{\#})}{rd} + \frac{e(1-n)}{rd}\left(\frac{zG + tj - tg}{t(h+v)}\right) + R^{\#}$$

If $R^{\#}$ was based on $g = 0$, then

$$i = mG/td - (E^{\#} + BC^{\#})/rd - e(1-n)g/r\,(h+v)d$$

Using the above solutions and all of the equations in the model, one finds that the ultimate change in each variable, in equilibrium,

following an increase in g from zero in an initial equilibrium to some permanent positive value is:

Change in R = -g/(h+v)
Y = 0
i = -e(1-n)g/r(h+v)d
B = -e((1-n)(a+f-d)+rd)g/r(h+v)d
BC = -eng/(h+v)
BM = e(1-n)(1-r)g/r(h+v)
BB = e(1-n-r)g/r(h+v)
BF = -fe(1-n)g/r(h+v)d
BH = -ae(1-n)g/r(h+v)d
C = -xg
E = eg/(h+v)
H = e(1-n)g/(h+v)
I = xg
M = e(1-n)g/r(h+v)
MD = e(1-n)g/r(h+v)
S = xg
T = 0
X = vg/(h+v)
Z = vg/(h+v)

National income ultimately drops back to its initial level, after a transitional stimulus. It is determined by aggregate demand, and is initially increased by the additional exports g. But ultimately, imports and exports are forced to equality in the foreign exchange market, and savings and investment are forced to equality in the bond (and money) market, and the only exogenous source remaining of aggregate demand is G, subject to the only remaining multiplier, 1/t.

If e, the degree of official intervention in the foreign exchange market, is zero, then we have the case of a perfectly freely floating exchange rate. If n equals one, then there is complete sterilization of changes in the foreign exchange reserves. In either case (e = 0 or n = 1), the additional exports, g, will have severely curtailed ultimate effects. Each of i, B, BM, BF, BH, H, M, and MD will return to their original levels. There will be a permanent effect on R, the price of foreign currency, and on the level at which exports and imports are equal. There will also be some shift of purchases away from consumption into investment in the industry producing g, and there will be some changes in the composition of the financial assets of the banking system. Similar effects could be achieved by

appropriate changes in the parameters G, t, and $BC^{\#}$, that is, by monetary and fiscal policy.

(vi) The System in Disequilibrium

The process of change in the economy may be more important than the long-run destination. The process starts now, while the destination may be far in the future, with a small discounted present value.

The process of change in this model becomes unwieldy to describe in algebra. Therefore we turn to a numerical example. Table B.1 is a summary of the symbols used in this model and a list of the numerical values applied.

Note that in this example e is set at 10. This means that the exchange rate regime is a sort of managed float in which the authorities intervene to resist but not ultimately to prevent movements in a floating rate. Also, note that n is set at 0.75. This means that three-quarters of any change in the foreign exchange reserves is sterilized, but the authorities do permit one-quarter of changes in the foreign exchange reserves to change the cash reserves of the banking system and thus the money supply.

Start with $g = 0$ in period 0, and then set $g = 1$ in period 1 and all subsequent periods. The system was in equilibrium in period 0, with initial values as set out in Table B.1. The behaviour of the model through time is set out in Table B.2.

As indicated in Table B.2, exports X are increased by g, but are gradually reduced again by the decline in R, that is, by the appreciation of the Canadian dollar. Since g never declines, it is exports of other products that fall. Imports Z are increased by both the rise in national income Y and by the fall in R (but R affects only their volume and not their value because a unit price-elasticity of demand for them is assumed).

The transient trade surplus is possible because, and only because, R does not fall immediately to a trade-balancing level. The fall in R is resisted by two pressures. First, there is direct official intervention in the foreign exchange market (and consequent increases in the foreign exchange reserves). Second, because the foreign exchange reserves are not fully sterilized, there is an expansion of the money supply, and a decline of the interest rate, and

TABLE B.1

VARIABLES, PARAMETERS, AND INITIAL VALUES FOR NUMERICAL EXAMPLE

Definition of Variable	Initial Value of Variable
B = stock of bonds in existence	$B^{\#} = 380$
BC = bonds held by central bank	$BC^{\#} = 2$
BM = bonds held by chartered banks	$BM^{\#} = 18$
BB = BC + BM	$BB^{\#} = 20$
BF = bonds held by foreigners	$BF^{\#} = 100$
BH = bonds held by households	$BH^{\#} = 260$
C = consumer expenditure	$C^{\#} = 70$
E = foreign exchange reserves	$E^{\#} = 0$
H = cash reserves of chartered banks	$H^{\#} = 2$
I = gross fixed capital formation	$I^{\#} = 0$
M = stock of money	$M^{\#} = 20$
MD = demand for money	$MD^{\#} = 20$
R = price of foreign currency	$R^{\#} = 1$
S = savings by households and business	$S^{\#} = 0$
T = taxes, net of transfer payments	$T^{\#} = 30$
X = exports	$X^{\#} = 20$
Y = gross national product	$Y^{\#} = 100$
Z = imports	$Z^{\#} = 20$
i = rate of interest	$i^{\#} = .05$
g = additional exports	$g^{\#} = 0$, thereafter $g = 1$

TABLE B.1 - (Continued)

Parameter			Value of Parameter
a	=	$\partial BH/\partial i$	= 1000
b	=	$\partial BH/\partial(1-t)Y$	= 3
c	=	$\partial C/\partial Y$	(not used explicitly)
d	=	$\partial MD/\partial i$	= 60
e	=	$\partial E/\partial R$	= 10
f	=	$\partial BF/\partial i$	= 2000
G	=	government expenditure	= 30
h	=	$\partial X/\partial R$	= 20
j	=	constant in equation for exports	= 0
k	=	degree of partial adjustment by households to desired bond holdings	= 0.1
m	=	$\partial MD/\partial Y$	= 0.23
n	=	degree of sterilization of change in foreign exchange reserves	= 0.75
r	=	cash reserve ratio of chartered banks	= 0.1
s	=	$\partial S/\partial Y$	(not used explicitly)
t	=	$\partial T/\partial Y$	= 0.3
v	=	$\partial Z/\partial R$	= 0
x	=	$\partial I/\partial g$	= 0.5
z	=	$\partial Z/\partial Y$	= 0.2

TABLE B.2

SIMULATION RESULTS

Time	i	R	Y	B	MD
0	.050	1.000	100.000	380.000	20.000
1	.050	.991	100.888	379.734	20.221
2	.049	.989	101.096	379.405	20.285
3	.049	.987	101.166	379.055	20.316
4	.049	.986	101.203	378.694	20.339
5	.049	.986	101.232	378.325	20.359
6	.049	.985	101.255	377.948	20.378
7	.048	.984	101.274	377.566	20.395
8	.048	.984	101.291	377.178	20.411
9	.048	.983	101.305	376.787	20.426
10	.048	.982	101.316	376.392	20.440
20	.046	.978	101.338	372.376	20.543
40	.044	.973	101.199	364.742	20.663
60	.041	.970	101.033	358.079	20.750
80	.040	.967	100.885	352.358	20.822
100	.038	.965	100.758	347.457	20.884
120	.037	.963	100.649	343.260	20.936
140	.036	.961	100.556	339.667	20.981
159	.035	.959	100.480	336.732	21.018
160	.035	.959	100.476	336.589	21.020
∞	.029	.950	100.000	318.250	21.250

Time	BC	BM	BB	BF	BH
0	2.000	18.000	20.000	100.000	260.000
1	1.934	18.199	20.133	99.443	260.159
2	1.915	18.256	20.171	98.915	260.319
3	1.905	18.284	20.189	98.413	260.452
4	1.898	18.305	20.203	97.934	260.557
5	1.892	18.323	20.215	97.476	260.633
6	1.887	18.340	20.227	97.036	260.685
7	1.882	18.355	20.237	96.614	260.715
8	1.877	18.370	20.246	96.207	260.725
9	1.872	18.383	20.255	95.814	260.717
10	1.868	18.396	20.264	95.435	260.694
20	1.837	18.489	20.326	92.160	259.890
40	1.801	18.597	20.398	87.076	257.268
60	1.775	18.675	20.450	82.918	254.711
80	1.753	18.740	20.493	79.382	252.482
100	1.735	18.795	20.530	76.357	250.570
120	1.719	18.843	20.562	73.768	248.931
140	1.706	18.883	20.589	71.550	247.528
159	1.695	18.916	20.611	69.739	246.382
160	1.694	18.918	20.612	69.651	246.327
∞	1.625	19.125	20.750	58.333	239.167

TABLE B.2 (Continued)

Time	C	E	GI	H	S
0	70.000	.000	.000	2.000	.000
1	69.742	.088	.500	2.022	.879
2	70.044	.114	.500	2.028	.724
3	70.151	.126	.500	2.032	.665
4	70.215	.136	.500	2.034	.627
5	70.265	.144	.500	2.036	.597
6	70.308	.151	.500	2.038	.571
7	70.345	.158	.500	2.039	.547
8	70.378	.164	.500	2.041	.526
9	70.406	.170	.500	2.043	.507
10	70.431	.176	.500	2.044	.490
20	70.539	.217	.500	2.054	.397
40	70.469	.265	.500	2.066	.370
60	70.339	.300	.500	2.075	.384
80	70.220	.329	.500	2.082	.400
100	70.117	.353	.500	2.088	.414
120	70.028	.375	.500	2.094	.426
140	69.952	.393	.500	2.098	.437
159	69.890	.407	.500	2.102	.446
160	69.887	.408	.500	2.102	.446
∞	69.500	.500	.500	2.125	.500

Time	T	T-G	X	X-Z	Z
0	30.000	.000	20.000	.000	20.000
1	30.266	.266	20.823	.646	20.178
2	30.329	.329	20.772	.553	20.219
3	30.350	.350	20.747	.514	20.233
4	30.361	.361	20.729	.488	20.241
5	30.369	.369	20.713	.466	20.246
6	30.376	.376	20.698	.447	20.251
7	30.382	.382	20.684	.429	20.255
8	30.387	.387	20.671	.413	20.258
9	30.391	.391	20.659	.399	20.261
10	30.395	.395	20.648	.385	20.263
20	30.401	.401	20.566	.298	20.268
40	30.360	.360	20.469	.230	20.240
60	30.310	.310	20.400	.193	20.207
80	30.266	.266	20.342	.165	20.177
100	30.227	.227	20.293	.141	20.152
120	30.195	.195	20.251	.121	20.130
140	30.167	.167	20.215	.104	20.111
159	30.144	.144	20.185	.090	20.096
160	30.143	.143	20.184	.089	20.095
∞	30.000	.000	20.000	.000	20.000

because of the latter a repatriation of some bonds from foreign holdings. It is this capital outflow that further resists the fall in r.

Table B.3 shows that, for example, in the first forty time periods in the model, the cumulative total value of g of 40 causes a cumulated trade surplus of 13.189, which is in effect used to add 0.265 to the foreign exchange reserves and to repatriate 12.924 of bonds.

Consumer expenditure is stimulated, both by the multiplier effect of the additional g exports and by the lowering of interest rates caused by growth of the money supply. The cumulative additional consumption in the first forty periods is 17.675. Household savings are reduced at the same time by 2.069 in cumulated total, but business savings, being half of g, are increased by 20 so total S is up by 17.931 in the first forty periods.

Aggregate demand (still as an accumulated total for the first forty periods) is increased by the sum of 17.675 of extra consumption, 20 of extra investment, and 13.189 of trade surplus, or by 50.864. Income is determined solely by aggregate demand and is thus increased by the same amount.

Because tax collections T vary with incomes while government spending G is constant at 30 per period, the increase in national income leads to a government budget surplus and thus to retirement of government debt. The stock of bonds in existence is reduced as a result, by 15.258 in the first forty periods. This reduction in the stock of bonds reinforces the decline in interest rates that monetary expansion is also causing.

In summary, the main early effects of additional exports g are:

(1) strengthening of the trade balance, the exchange rate, and the foreign exchange reserves;
(2) expansion of the money supply, reduction of the government debt, and reduced interest rates;
(3) higher consumption, investment, and income; and
(4) reduction of international indebtedness (if one assumes that the g-financed new investment is not foreign owned).

If the g-exports were to end at any time, all these effects would appear in reverse.

If the g-exports are maintained permanently, the long-run effects are:

TABLE B.3

CUMULATIVE VALUES OF CERTAIN VARIABLES IN THE NUMERICAL EXAMPLE

Period	g	ΔE	ΔBF	(ΔE-ΔBF) = (X-Z)	I	(C-70)	S	(T-30) =ΔB	(Y-100)
Σ 1-40	40	.265	-12.924	13.189	20	17.675	17.931	15.258	50.864
Σ 41-80	40	.064	-7.694	7.758	20	13.523	15.373	12.384	41.28
Σ 81-120	40	.046	-5.614	5.660	20	4.669	16.563	9.098	30.33
Σ121-160	40	.033	-4.117	4.150	20	-1.911	17.480	6.671	22.24
Σ 1-160	160	.408	-30.349	30.757	80	33.942	67.347	43.411	144.70
Σ 1-∞	∞	.500	-41.667	42.167	∞	∞	∞	61.750	205.83

(1) the exchange rate levels off at a lower (stronger) value, and the stock of foreign exchange reserves levels off at a larger amount;
(2) there is a permanently larger money supply, a smaller government debt, and a lower interest rate;
(3) there is a permanently smaller international indebtedness (assuming the g-financed new investments are not foreign owned);
(4) the trade surplus disappears, as g-exports displace other exports and encourage imports through a lower exchange rate;
(5) national income returns to its original level as the spurt of extra aggregate demand arising from the trade surplus and from lower interest rates dries up; and
(6) consumer expenditure declines and levels off at a rate below its original level, as it is displaced by the business savings from g-revenues.

Note that in every respect, except for new g-financed investment, the ratio of benefits to g-exports declines steadily through time. For example, in the first forty periods, additional Y of 50.864 is caused by g of 40. But in the fourth forty periods, g of 40 yields only 22.240 of extra Y. This general decline over longer horizons of 'benefit:cost ratios' would be aggravated if the g-exports consist of an exhaustible resource, sustained exports of which would become increasingly costly through time.

Note also that monetary and fiscal policy used directly in appropriate combination can achieve the same favourable effects on income, consumption, the trade balance, and foreign indebtedness. However, they can do so directly only while reducing the foreign exchange reserves or raising (weakening) the exchange rate, unless there is some exogenous increase in exports or decrease in imports to offset the strain on the balance of international payments.

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